ally decay, following an exponential law, and reaching half value in forty years. But should the supply of emanation in the future equal that in the past, the activity would continue to increase in magnitude for the next hundred years or so, until the supply and decay of radium D attained a steady value. By that time radio-active experiments of a delicate nature would become difficult or impossible, as the excited activity would rapidly discharge a gold-leaf electroscope.

As the excited activity can be largely removed by acid, the infection will at present cause no serious difficulty in the majority of experiments on radio-activity, particularly as the leak arising from it remains almost constant for weeks or months. But when an electroscope with a very small natural leak is required, it will be necessary to employ fresh materials which have not been exposed to emanation.

It appears desirable, in the case of laboratories not yet infected, to keep radium in sealed vessels, and to blow the emanation into the open air, and not into the rooms of the laboratories.

A. S. Eve.

McGill University, Montreal, February 25.

International Atomic Weights.

The committees engaged in revising the tables of atomic weights have now sent in their reports for 1905. The one which appeared in the *Berichte* is, of course, printed in German, and that which has just been circulated by the Chemical Society is in English.

Unfortunately, there is a want of uniformity in the naming of the elements. Thus, in the English table we find Glucinum, Gl, and Columbium, Cb, whereas in the German table these elements are called Berylium, Be, and Niobium, Nb, respectively. Historically, no doubt, the names adopted in the English table are more accurate. But in all text-books the names and symbols employed in the German tables are used, and have been for many years.

It is difficult to see where the advantage in making the change comes in, but, on the other hand, the disadvantages of having two forms of nomenclature are obvious.

F. Mollwo Perkin.

London, March 8.

The Planet Fortuna.

Perhaps Airy quoted his Juvenal correctly, which "W. E. P." (p. 410) has failed to do. The poet was so well satisfied with the lines that he gives them twice, in his tenth and fourteenth satires. And they run thus:—

Nullum numen habes, si sit prudentia; nos te
Nos facimus, Fortuna, deam cæloque locamus.

W. T.

The lines are variously quoted, and I cannot say what version Airy favoured. I believe he spoke from memory.

W. E. P.

COSTA RICA.[1]

Up to 1540, Spain had reserved for the crown that part of the territory of Veragua lying west of the portion which had been granted to the heirs of Columbus; but, in that year, it was erected into a province and called Costa Rica. It lies between Nicaragua and the newly hatched, but featherless, republic of Panama, and is the smallest State of the New World except Salvador. But it is one of the most interesting, for, with Panamá, it forms the connecting link between North and South America, not only physically but ethnologically. If more were known of its ancient inhabitants, their type, character, modes of life, habits and customs, inter-tribal relations and forms of worship, and of the ruins of ancient towns and burial places which are silently dotted over the country, one might go far towards a solution of many vexed problems as to the relation betwen early Mexican culture and that of the Andean peoples—Chibchas of ancient Cundinamarca, the Quitos and Cañaris of Ecuador, the Quichuas and Aymaras of the Inga empire. Much of the data necessary to the formation of a just conclusion are buried on the slopes of the volcanoes of Turrialba, Irazu, Barba and Poas, and, in that richest of fields for archæological research, the district lying between Lake Nicaragua and the Gulf of Nicoya on the Pacific coast of Costa Rica, while the lowlands lying between Nicaragua and the Atrato River of Colombia probably hide, under their densely matted and almost impenetrable vegetation, whatever evidences may exist of their occupation by man, not only in the far-remote past, but even at the date of the Spanish conquest.

Hence we may welcome a scientific examination of any section of the region outlined above, but especially when the results are so carefully and clearly set forth as they are in the work under review—a large quarto volume richly illustrated. Its publication, as well as the explorations of which it treats, have been made at the expense of Mr. Åke Sjogren, who has presented to the Royal Ethnological Museum of Stockholm the valuable archæological collection with which Mr. Hartman returned home. This gentleman, whose studies had well equipped him for his task, proceeded to Costa Rica in 1897, where he remained more than a year in the territory once occupied by the Guëtare race. He commenced his researches in May (the beginning of the rainy season) near the *hacienda* of Mercedes, which is situated on the Guapiles branch of the Costa Rica Railway, about fifty miles from Port Limon.

"On the Atlantic side, the moisture-laden atmosphere and tropical heat have clothed the mountain chains and the low swamp lands with eternal verdure, with forests which are almost impenetrable, woven together as they are by lianas passing from tree to tree. Neither aboriginal nor Spanish culture ever made great inroads on the primeval forests of the Atlantic coast."

Near Mercedes is a mound about 100 feet in diameter at the base, 65 feet at the top, and 20 feet high. It is in a partially walled enclosure, and probably served as a platform on which to erect statues facing the rising sun. The mound may have been covered with a wooden structure with a thatched roof. Among the many human figures found there, all mutilated, were two of life size one of which is notable as having ear plugs. The chest and back are crossed by two thick ropes, which pass over the shoulders and reach to the hips. The right wrist supports a human head. The other large statue has its hands resting on the hips. The heads of both figures are covered with conical hats. Rudely sculptured representations of alligators, pumas, and other animals were found, but in fragments. All of these, including the statues, were cut from hard, basaltic lava.

Mr. Hartman also examined the extensive burial places of the ancient inhabitants of this district, and opened a great number of cists. These varied in dimensions, but it is apparent that they were rarely intended for the interment of more than one person. They had side and end walls of cobble stones, but the bottom and top were of slabs of limestone. The horizontal section of the cists was very irregular. Only in one did he find traces of bone, but the "dark soil near the bottom seemed to prove that the body or bodies had been placed there."

Many vessels of burnt clay, sometimes roughly decorated, were lying in the cists, but a great part of them, covered with soot, appear to have served as cooking utensils. Several contained charred maize and fragments of corn cobs. In one was found some Millefiori beads, the manufacture of which was an important industry in Venice during the latter part of the fifteenth century, and the author says that, "Later on, I discovered a number of this kind in a grave at Osori in the highlands."

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[1] "Archæological Researches in Costa Rica." By C. V. Hartman. The Royal Ethnological Museum in Stockholm. Pp. 195; map+87 plates. (Stockholm: C. E. Fritzes, 1901.)

Thus it appears that these Indian towns were still in existence at the time of the Spanish invasion.

Mr. Hartman also opened a *cache,* similar to a cist, but there was no proof that it had ever been used as a grave; in fact, it was too small. It contained sixteen clay vessels, some of them ornamented, and much broken pottery. There were several globular bowls and vases. "The practice of secreting household articles as well as food in pits or in caves has from early days been observed among widely disseminated tribes of North America."

The work-yard of the ancient stone-cutters was happily discovered, and many unfinished idols were lying about.

In June, 1895, I roughly examined the mounds and some of the graves near the *hacienda* of Mercedes, and especially remember the two great statues described by Mr. Hartman. People resident in the vicinity, who know much of the region, said that the whole Santa Clara district, occupying the slopes of Turrialba, Irazu and Barba, and the heavily forested lowlands to the north and east, are dotted with ancient burial grounds.

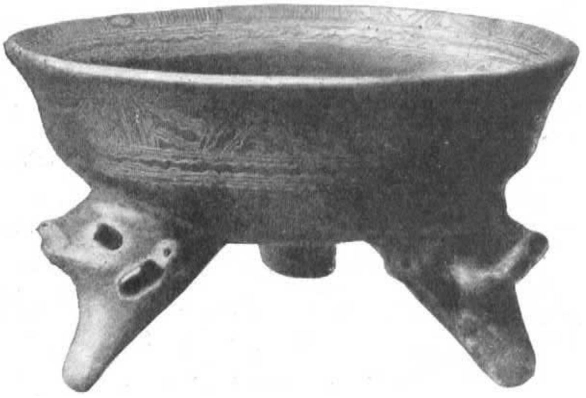

FIG. 1.—Shallow, tripod bowl found in Field II., Chircot. Height, 12·8 cm.; Diameter, 22 cm. From "Archæological Researches in Costa Rica."

From the coast lands, Mr. Hartman ascended to the highland plains near Cartago, one and a half miles west of which town is the water divide, 5100 feet elevation, between the Atlantic and Pacific Oceans. Cartago is about 4800 feet above sea-level, and lies upon the southern slope of the volcano of Irazú, the only one of Costa Rica which has ejected compact lavas. In its eruptions of 1841 and 1851 it almost completely destroyed Cartago, which was the former capital of Costa Rica. In its vicinity Mr. Hartman uncovered numerous cists similar to those of Mercedes, but they contained a greater variety of potsherds and ornamental pottery. He made especially rich collections at a spot called Chircot, where he observed that a favourite figure of the ancient artists was a flute-playing god. In the stone-bordered necropolis at this place he found 205 cists, many of them in three layers. In about thirty there were skeletons, or fragments of skeletons, which averaged five feet in length. The skulls were dolichocephalic, but most of the remains were too decayed for removal. Summarising his year's work, he says of the culture of the Guëtares "that it proves to be that of a stone-age people of high standing, possessed of ornaments of gold and copper, but with no tools or weapons of metal at all. We have no data whatever to enable us to determine how far back into the past this culture reaches, but the presence of beads of glass in the graves goes to show that it continued to exist after the arrival of the Spaniards. No traces of a more primitive culture were met with."

Similar cists are to be found on the slopes of Popocatapetl in Mexico, Zaculen in Guatemala, Chiriqui in Panama, and at Arayo in the Cauca valley of Colombia. In outline and elegance, the clay vessels of the Guëtares are inferior to those found in Chiriqui, but the objects in stone from the two sources closely resemble each other.

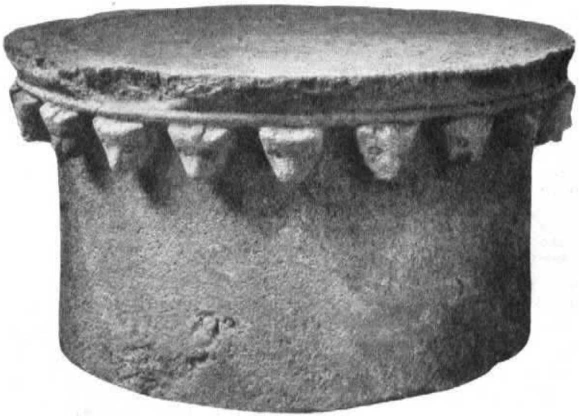

FIG. 2.—Seat of Stone. Found in the forest in the neighbourhood of the large mound, Mercedes. From "Archæological Researches in Costa Rica."

It is to be regretted that Mr. Hartman has not given us his views as to the ethnological relations of the Guëtares to the other aboriginal tribes of Central America. No doubt, in his travels subsequent to the researches so elaborately detailed in his valuable volume, he must have formed opinions of much importance to the student of aboriginal America. Costa Rica was a debatable ground between the Mexican race and the warlike Carib of the northern shore of South America. It may, perhaps, be conceded that an offshoot of the highland people of Mexico pressed south and east from Chiapas into and through the long strip of the Pacific coast occupied by the Chorotegas or Mangues, followed the Pacific slope of the Cordillera and the narrow belt of land between Lake Nicaragua and the ocean, penetrated into north-western Costa Rica, settled and helped the Mangues to develop a considerable civilisation in the Guanacaste and Nicoya districts, and in part subdued all the mountainous area lying north and west of the river Reventazon. The culture which was characteristic of the region indicated was infinitely superior to anything attained by the Guëtares, for the Mangue-Nahua people carried some of the arts, such as pottery, sculpture, weaving, and tilling the ground, to greater perfection than any of the tribes occupying the territory between theirs and that of the Chibchas of the plateau of Bogota. In their graves are found examples of the ceramic art and gold ornaments showing taste in design superior to any that the present civilised Indian of Costa Rica can equal. Their graves produce beautiful specimens of obsidian, greenstone, and finely wrought nephrite tools and jade ornaments, knives, hatchets, arrowheads, armlets, rings, and a multitude of stone seats and idols.

Let us hope that Mr. Hartman may follow up his good and useful work by an exploration of the northwestern slope of the country which has been the scene of his labours. GEORGE EARL CHURCH.

PROGRESS IN AËRIAL NAVIGATION.

THE problem of aërial navigation has been attacked by direct methods for so many centuries that the results of the recent aëronautical competition at St. Louis can scarcely be regarded as a matter of surprise. It is doubtful whether the offering of large prizes for the achievement of a result which has been attempted for years without success is the best means of promoting progress. As will have been learnt from the daily Press the great prize of 20,000*l.* was not even competed for, and a much more useful purpose would have been served by a systematic and organised attempt to encourage, by means of prizes, investigations calculated to throw an indirect light on the general question of aërial navigation, such, for example, as improvements in the efficiency of propellers, diminution of the angle of gliding of gravity-propelled machines, reduction of air-resistance of motor-propelled balloons, solution of the difficulties connected with longitudinal stability, especially in gliding machines travelling at low speeds, and what is still more important, the discovery of new results in any direction whatever calculated to open up fresh methods of approaching the whole question.

If we chronicle merely the attempts that have successfully been made in striking out on new lines, leaving out of account improvements subsequently made on the same lines, and also omitting early attempts such as those of Dante of Perugia and Le Bris, a history of aërial navigation will be summed up in the following short list:—(1) Montgolfier's discovery of the balloon; (2) application of mechanical power to the propulsion of balloons by Renard and Krebs; (3) introduction of gliding experiments under gravity by Lilienthal; (4) the introduction of explosion engines and other light motors theoretically capable of maintaining a flying machine in the air. Each of these innovations has brought the goal more distinctly in view, and yet experiments so far have left a wide gap between the results of actual performance and what is necessary to render aërial navigation practically useful. The special difficulty connected with aërial navigation is that it is not easy to see how to approach the problem except by direct methods of attack, while the great majority of scientific discoveries have been made indirectly as the result of observations originally undertaken for some entirely different object that has been known from the very outset to be possible of attainment.

By analogy with fishes and birds, respectively, the two forms of machine experimented on, involving as they do the use of gas bags and aëroplanes or aërocurves, might not inappropriately be described as the aërial swimming machine and the flying machine proper. It is somewhat remarkable in the face of natural evidence that the swimming machine has up to the present proved by far the most tractable of the two, and has undoubtedly led to the best results. It is the safest to experiment with. That accidents have frequently occurred is perfectly true, but they have all been attributable to causes not beyond the ken of an ordinary practical but intelligent mechanic.

Of aërial swimmers constructed within the last few years the most notable ones are undoubtedly the Santos Dumont series, the ill-fated De Bradski airship, the Lebaudy, Barton, Spencer, Baldwin, Benbow, Beedle, and Deutsch forms. A few details of these, collected for comparison, may be of interest.

M. Santos Dumont's No. 7 is 160 feet long and 23 feet in diameter, and is provided with a four-cylinder motor capable of developing 60 horse-power and making 1200 revolutions per minute. Its predecessor, No. 6, was 108 feet long and 20 feet in diameter, with a motor of 16-20 horse-power. This was the machine which won the Deutsch prize, and its speed relative to the air was probably about 19 miles an hour. No. 7 was originally intended to compete at St. Louis, but M. Santos Dumont did not enter.

The De Bradski airship is now a thing of the past. It was 111 feet long and weighed about 1923lb., and a special feature was that the machine was not *quite* light enough to raise itself, the ascent being effected by a screw revolving in a horizontal plane. The experiment ended in October, 1902, with a fatal accident, the airship becoming unmanageable, and the car breaking away owing to the weakness of its supporting wires.

The experiments of MM. Lebaudy have been remarkably successful in spite of an accident which destroyed their first machine in November, 1903. This did not deter these indefatigable aëronauts from constructing, partly out of the wreckage of the old one, a new machine of the following dimensions:—Length 58 metres, greatest diameter 9·8 metres, volume of gas 2600 cubic metres, or about 94,000 cubic feet; motor, a four-cylinder Daimler of 40 horse-power running at 250 to 1200 revolutions per minute; propellers, two screws 2·44 metres in diameter running at 800 to 1000 revolutions per minute. Of the thirty voyages made with this "aërial cruiser" in 1904, the following appear to have been the most successful:—August 16, a distance of 16 miles in 41 minutes; November 22, a run of 1 hour 33 minutes. An accident occurred on August 28 owing to the "swimmer" breaking loose, but it floated away to a distance and finally got caught in a wood 70 kilometres distant, whence it was brought back with slight damage. The present model is remarkably like a fish in shape, and the resemblance is further accentuated by the tail-like double horizontal rudder in the stern. The balloon has a flat base with a long vertical keel, and all these arrangements are well calculated to make it travel steadily.

Beyond the mere rumour of an accident last spring the Barton airship seems to have lapsed into oblivion of late, but it must not be forgotten that a year is small interval of time in the construction of aëronautical machines. The dimensions given are as follows:—Length of balloon 170 feet, diameter 40 feet, total estimated weight 15,700lb.; number of propellers, six, each consisting of six blades arranged tandem fashion, placed in pairs, one on each side of each motor; motors, three in number, developing 50 horse-power each, and running at 1600 revolutions. A peculiarity of Dr. Barton's design is the series of aëroplanes, thirty in number, employed to raise the machine. The shape of the balloon and the structure of the underlying framework and car suggest the possibility of considerable head resistance.

Of the performances of Messrs. Spencer's airship satisfactory records were given in the Press at the time. The dimensions are:—Length 93 feet, diameter 24 feet; propeller, a single screw 12 feet in diameter, placed in front; engine of 24 horse-power running at 1050 revolutions.

Mr. Baldwin's and Mr. Benbow's airships, exhibited at St. Louis, appear not to have made any